INTRODUCTION TO SOIL SCIENCE

DEFINITION OF SOIL: Loose material covering the earth's surface and supporting the growth of plants

Unconsolidated or loose combination of inorganic or organic materials

Inorganic components- products of rocks and minerals broken down by weather, chemical action and other natural processes

Organic components- debris from plants and animals, decomposition of many life forms inhabiting the earth.

A living system combining with air, water and sunlight to sustain plant life

- BASIC TRUTH ABOUT SOIL : (a) Composed of mineral matter , organic matter (both living and dead), water and air,
- (b) Occurs at the interface between the **LITHOSPHERE**, the **HYDROSPHERE,** the **BIOSPHERE** and the **ATMOSPHERE** ,
- The soil ecosystem contains components of all these **SPHERES** (IITA) .

FACTORS AND PROCESSES OF SOIL FORMATION

- Soil formation is an ongoing process through the combined effects of five soil forming factors:(a) Parent material,(b) Climate, (c) Living organisms:(d) Topography, and (e) Time.
- Each combination of the five factors produces a unique type of soil that can be identified by its characteristic layers called horizons.
- Soil formation is also known as pedogenesis (from the Greek word ‘pedon’ for ground and ‘genesis’ meaning birth or origin .

- PARENT MATERIAL :
- The first step in pedogenesis is the formation of parent material from which the soil itself forms .
- About 99% of the world's soils derive from mineral-based parent material that are the result of weathering- the physical disintegration and chemical decomposition of exposed bedrock .
- The remaining % derives from organic parent material- the product of environments where organic matter accumulates faster than it decomposes, i.e. in marshes,bogs and wetlands.

- Bedrock itself does not give rise to soil.
- Gradual weathering of bedrock produces REGOLITH a layer of loose rock debris or mantle ,
- Further weathering of this debris leading to increasingly smaller and finer particles ultimately results in the creation of soil .

- CLIMATE :
- Water, Ice, Wind, Heat and Cold are elements of climate causing physical weathering by loosening and breaking up of rocks .
- Climate also determines the speed or rate of chemical weathering .
- Climate also influences the developing soil by determining the types of plant growth that occur, i.e. low rainfall discourages the growth of trees but encourages the growth of grass .

- LIVING ORGANISMS :
- As parent material accumulates, living things begin to grow marking the formation of true soil. Mosses, lichens and other lower plants appear first .
- As they die, the remains add humus to the soil for the growth of higher plants .
- Plants trap dust from volcanoes and deserts.
- Growing roots break up rocks .
- Animals mix soils by tunneling in them .

- TOPOGRAPHY or RELIEF :
- Degree of slope on which a soil forms helps to determine how much rainfall will run off the surface and how much will be retained.
- TIME :
- Soil formation time varies according to the action of the other soil forming factors. Young soils may develop a few days from alluvium or from volcanic ash eruptions. Other soils may take thousands or millions of years to form .

- As soils develop, they are arranged in a series of layers known as horizons starting at the surface and proceeding deeper into the ground reflecting different properties and different degrees of weathering .
- A typical soil profile has the surface horizon as the O layer consisting of loose OM such as fallen leaves and other organic biomass.
- Below this is the A horizon containing a mixture of inorganic mineral materials and OM .

- Next is the B horizon in which iron, clays and other mineral materials have accumulated .
- Under this layer is the C horizon consisting of partially weathered rock .
- Lastly, is the R horizon of hard bedrock .
- Each horizon may have many subordinate names to describe the transitional areas between the main horizons .

- Different combinations of the five soil forming factors produce different types of soils.
- Soil types are the results of parent material, organic matter, air, water and living organisms acted upon by the five soil forming factors.
- Soil characteristics include, texture, structure, porosity, colour, stoniness, fauna, flora, nature and types of horizon, consistence, inclusions, boundaries, chemical properties, etc.

- Perhaps, the most important characteristic of the soil is the SOIL TEXTURE.
- Soil texture is the relative proportion of sand, silt and clay.
- Soil texture refers to the fineness or coarseness of the soil.
- It also refers to the ‘feel’ of the moist soil resulting from the mixture of the constituent mineral particles and organic matter.

- CLASSES of TEXTURE are based on various combinations of sand, silt and clay.
- When soil is separated into its aggregates, the percentage of each of the aggregates should all add up to 100% giving the soil its class of texture using soil textural triangle.
- For example, Sand = 70%, Clay = 20% and Silt = 10%, then the textural class is Loam.

- SOIL TEXTURAL CLASS names include: Sand, Loamy sand, Sandy loam, Loam, Silty loam, Silt, Sandy clay loam, Clay loam, Silty clay loam, Sandy clay, Silty clay and Clay.
- The name of the textural class is that of the textural fraction whose properties dominate the soil properties, except loam in which no one fraction dominates.

- Properties of ‘Good’ soils include, medium textures like Loam, Silty loam, Silt, Sandy clay loam and Sandy loam.
- Others properties include good aeration (moderately porous), optimum moisture holding capacity, good structure (angular blocky, sub-angular blocky, prismatic, etc.), good organic matter content (> 1.0 %), fertile (ECEC of at least 12-25 cmol/kg of soil), well drained and occurring on relatively flat to gently undulating land.

TYPES OF FERTILIZERS FOR SOIL IMPROVEMENT

- Soils under virgin vegetation are generally fertile and able to support optimum and profitable crop production after bush clearing.
- Fertility begins to decrease after 2 or 3 cropping seasons requiring nutrients addition in terms of fertilizer supplementation for sustainable and profitable crop production.
- FERTILIZERS are any natural or manufactured material which contains at least 5% of one or more of the primary nutrients (N,P,K).

- Organic Fertilizers are fertilizers from plant and animal remains, i.e. poultry droppings, cow dung, compost manure etc.
- Industrially manufactured fertilizers are called mineral fertilizers.
- Straight or simple fertilizers – Fertilizers containing only one primary nutrient, i. e. Urea (46 % N), Sulphate of ammonia (21% N and 23% S) Calcium ammonium nitrate (27% N), Single superphosphate (16-20% $P_2 0_5$), Triple superphosphate (46% P_2O_5) and Muriates of potash (60% K_2O_5).

Multinutrient Fertilizers- contains 2 or 3 primary nutrients, i.e. NPK 15-15-15, NPK 20-10-10, NPK 20-10-0, NPK 12-12-17 + 2MgO, etc.

Soil Tests are carried out to determine nutrient levels before planting.

Based on the results, type and rates of fertilizers to apply are determined.

Application methods include, Broadcasting, Row or Band placement, Top dressing, Side dressing and Foliar application.